Development and Characterisation of a Stent-like Z-shaped Wireless Implantable Sensor for Aneurysm Size Detection

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Abstract—Abdominal aortic aneurysm (AAA) is a dilation of the aorta artery larger than the normal diameter of the artery (> 3 cm) in the abdominal region. Endovascular abdominal aortic repair (EVAR) is the main treatment option for AAA, that involves deploying a graft into the diseased portion of the aorta artery. Hence, creating a new pathway for blood flow and preventing the risk of rupture. This treatment requires follow-up routine on the first and sixth month, and yearly afterwards; which is time-consuming, costly, and resource-demanding for healthcare systems. An alternative approach to traditional imaging modalities used in the follow-up routine is the implantation of a wireless sensor. In this study, a novel wireless implantable sensor with a stent-like Z-shaped configuration is proposed with the objective of tracking the growth of the aneurysm. The proposed sensor is based on an inductor that is designed in a sequential ring of six struts inspired by stent-struts. The inductor has the ability to expand and contract with a change in the diameter of the aneurysm. This study aims to characterise the electrical characteristics of the inductor as the inductor expands with a growing abdominal aortic aneurysm. An analytical expression was developed to define the geometric changes in the inductor that occur over the growth of the aneurysm, and are responsible for the changes in the electrical characteristics of the inductor. Electrical characteristics, including inductance, resistance, and quality factor, were observed in the numerical and experimental evaluation of the performance of the inductor with varying radii. The experimental and numerical results showed that an increase of radius from 5 to 50 mm resulted in an increase of 77% and 106% of inductance, respectively. Moreover, the average percentage difference between the numerical and experimental inductance values was found to be 10%. The resistance of the sensor coil remains constant during expansion. The preliminary findings of this study showed that the proposed sensor can be used to track the corresponding expansion of the aortic aneurysm over time.

Figure 1: Projection of the implantable sensor designed with a Z-shaped configuration to help detect the growth of abdominal aortic aneurysm. This inductor is made of annealed copper, constituted by six struts and a diameter of 70 mm.

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